RIODICAL
9(3541)
119(3541)

Proceedings of the United States National Museum

SMITHSONIAN INSTITUTION • WASHINGTON, D.C.

Volume 119 1966 Number 3541

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By J. LAURENS BARNARD

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Proceedings of
the United States
National Museum

SMITHSONIAN INSTITUTION • WASHINGTON, D.C.

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BENTHIC AMPHIPODA OF MONTEREY BAY, CALIFORNIA

By J. Laurens Barnard
Associate Curator, Division of Crustacea

The fauna of benthic subintertidal Amphipoda in Monterey Bay, California is compared to that of southern California south of Point Conception. This study of northern Amphipoda complements a study of southern Amphipoda of Baja California (Barnard, 1964a). The two surveys have been conducted in order to determine the affinities of various Amphipoda of southern California.

The extrinsic distributions of southern California Amphipoda are poorly known except for those species from Baja California reported by Shoemaker (1925, 1942), Barnard (1964a), and those from Oregon, Washington, and British Columbia reported by Calman (1898), Walker (1898), Thorsteinson (1941), Barnard (1954), Bousfield (1958), and Mills (1961, 1962). Most of the cited papers have treated only intertidal species. Although Monterey Bay has not been considered to be a typical cold-temperate area, the present analyses indicate the cold-temperate character of several California Amphipoda.

I am indebted to Dr. R. E. Stevenson of Florida State University, formerly of the Allan Hancock Foundation, who directed the California State Water Pollution Control Board survey of California.

G. F. Jones, aboard the RV/*Velero IV*, was instrumental in collecting and processing the samples. Captain Fred C. Ziesenhenne identified the ophiuroids dominating the bottom samples. Dr. Joel W. Hedgpeth of Pacific Marine Station loaned specimens of a new species of *Protomedeia*. The Beaudette Foundation and the Smithsonian Institution supported the project and the National Science Foundation provided funds for illustration (grant G–10750).

Methods and Data

The benthos of Monterey Bay, in water depths of 15 to 116 m (table 1) is represented by those 46 samples charted in figure 1. They are relatively evenly distributed in proportion to bathymetry. The coastal benthos of southern California is represented by 348 samples evenly proportioned to depths between 10 and 200 m. The two groups of samples, although disparate, are roughly proportional in number to their respective bottom areas. Any comparisons between the Amphipoda of the two areas must be viewed with caution.

Samples of sediment and fauna were collected with an orange-peel grab taking a surface area of 0.25 m^2. Barnard and Jones (1960) have considered the average mechanical efficiency of the grab to be about 80 percent if large numbers of samples are taken on diverse substrates. The efficiency decreases on hard-packed sand bottoms and increases on soft silty bottoms. Calculations of frequencies of Amphipoda in the 348 southern California samples employed the 80 percent efficiency rule. Those of Monterey Bay employed a 100 percent efficiency rule. All sedimentary samples from Monterey Bay, with one exception, exceeded 1.5 m^3, the mark of 100 percent efficiency. Presumably differences in depth of penetration of the grab in those samples of 100 percent areal efficiency would not affect tallies of Amphipoda except for those listriellas inhabiting deep burrows of polychaetes and echiuroids.

Sedimentary samples were washed through meshes of 0.7 mm square openings and the residues preserved in a mixture of seawater and formaldehyde. Amphipoda and those other animals considered to be dominants in the samples were removed to alcohol in the laboratory. The remaining materials were represerved and stored in the collections of the Allan Hancock Foundation. Thorson's (1957) methods were used to determine standing-crop dominance.

Planning and conducting of the surveys were based on USHO charts contoured in English fathoms, but the bathymetric data have been converted to meters herein. Hence the depth classifications of benthic areas in southern California, quoted in meters, are not in standard intervals of 10, 20, 30 m, etc., but are in converted intervals of 10, 20, 30, etc., fms.

Geographic Positions and Environments

The region of southern California, with a median latitude of 33° N, extends from Point Conception on the north to the international border between California amd Mexico on the south. The coastal length is approximately 300 km. Monterey Bay, with a latitude of approximately 36.5° N, lies 275 km north of Point Conception. The bay occurs near the southern end of the cold-temperate Oregonian zoogeographic province and is within the Montereyan subprovince. Monterey Bay is broad, semilunar, and about 30 km wide. Its shelf is narrow and cut by the shoreward ends of the Monterey Canyon complex occurring just north of the area shown in figure 1. The benthic enviroment, except for intertidal areas, has been scarcely explored, but several known environmental differences between Monterey Bay and southern California are explained below.

Surface waters of Monterey Bay are dominated by the upwelling of cool subsurface layers (California Cooperative Fishery Investigations, 1952–1964). Sea-surface temperatures vary between 10° and 14° C. The average sea-surface temperature of southern California, at 33° N during 1957–1960, was about 17.5°, and the range was 14° to 23° C (Jones and Barnard, 1963). Upwelling occurs from place to place and is especially prominent in the Gulf of Santa Barbara, where waters are entrained by the California current.

The shelf of the southern part of Monterey Bay lies in greater water depths than do Santa Monica Bay (Hartman, 1956) and San Pedro Bay (Barnard and Ziesenhenne, 1961) of southern California. Very little of Monterey Bay is shallower than 37 m (20 fms). Those southern bays have a large share of benthic area in the 27–46 m (15–25 fms) depth interval. As a result, the benthic fauna of Monterey Bay is dominated by deep-water ophiuroid communities, whereas the southern bays are dominated by shallow-water ophiuroid communities or nonophiuroid communities. The distribution of the communities in Monterey Bay is shown in figure 1. Contours are necessarily diagrammatic because of low sampling frequencies. The principal ophiuroids are *Amphioda urtica* (Lyman), *Amphipholis squamata* (Delle Chiaje), *Amphiura arcystata* H. L. Clark, and *Amphioplus strongyloplax* (H. L. Clark). The southern bays are dominated principally by the *Amphioplus hexacanthus* H. L. Clark community (Barnard and Ziesenhenne, 1961), which occurs only on the inshore margins of Monterey Bay. The deep-water *Amphiodia urtica* is the common dominant of the outer shelf of southern California. The prevalence of *A. strongyloplax*, *A. amphacantha*, and *A. arcystata* in depths of less than 100 m in Monterey Bay is a reflection of the northern emergence of communities occurring in southern California

only on coastal slopes in depths exceeding 120 m. These communities have not been sampled frequently in southern California because of steeply sloping bottoms and diffuse sampling grids.

The headland of Monterey Peninsula has a rocky substrate but to the northeast a long, slightly concave shoreline is composed of sand beach. A community dominated by the polychaete *Nothria* species occurs on inshore sand bottoms in depths of less than 30 m; presumably it is similar to that described from southern California by Barnard (1963).

The Amphipod Fauna

Because most of the Monterey shelf lies in depths exceeding 50 m, the station grid embraces only 13 samples in depths of 10 to 50 m. Those few samples have little comparative significance to samples from southern California. Thus, this discussion is confined to the 33 samples from depths of 50 to 139 m. The Amphipoda occurring in Monterey Bay are listed in rank in table 2, with their frequencies of individuals and their limitations to depths of 50 to 139 m. They are compared with rankings of species from similar depths in southern California (tables 3, 4, 5, 6).

Half of the 20 most abundant species occurring in southern Californian depths of 94–183 m (table 6) also occur in the first 20 of Monterey Bay in depths of 50–139 m (table 2). Those southern California species not found in the list of abundant Monterey species are *Ampelisca pacifica*, *Westwoodilla caecula*, *Ampelisca brevisimulata*, *Orchomene decipiens*, *Nicippe tumida*, *Ampelisca pugetica*, *Lysianassa holmesi*, *Paraphoxus robustus*, *Pardisynopia synopiae*, and *Lysianassa oculata* (the latter is number 22 in Monterey Bay). Because all of those species do occur in low frequency in Monterey Bay, this poor comparison is probably a circumstance of low sampling frequency. These data also indicate that shallow waters of Monterey Bay, despite the occurrence of upwelling, are too warm for the occurrence of deep-water species.

A 50 percent correspondence in predominant species occurring both on the Monterey deep shelf and in southern California depths of 75 to 92 m also occurs (table 5). Some deep-water species, i.e., *Nicippe tumida* and *Pardisynopia synopiae*, occur dominantly in the southern California section but not in Monterey Bay.

Only 8 of the 20 predominant species occurring in depths of 57 to 73 m also predominate in Monterey Bay. Similarly, neither *Nicippe tumida* nor *Urothoe varvarini* are abundant in Monterey Bay (table 4). The same is true in depths of 39 to 55 m (table 3).

These poor faunal congruencies may result from the low densities of the individual species in the Monterey samples. For instance,

the 20 species of Monterey Bay occurring most frequently (1–21, less 3) tally 220 individuals per m^2, whereas they tally 493 individuals in southern California depths of 75–92 and 94–183 m. The frequency of the 20th most abundant species in Monterey Bay is 2.4 individuals whereas the 20th of southern California is about 7.0 individuals per m^2. Fifty-eight species occur on the deep shelf of Monterey but more than 110 species occur in depths of 75 to 183 m in southern California. Of the 110 southern California species, 12 have frequencies of less than 0.2 individuals per m^2 and 39 have less than 1.0 individuals. This demonstrates the influence of sampling frequency.

All 58 species of the Monterey deep shelf occur in southern California except for *Centromedon pavor* and *Protomedeia penates*. In shallow waters, only *Eohaustorius sencillus* (of 23 species not found in the deep zone) is not recorded from southern California. This strong relationship is a result of the extreme intermixture of northern and southern elements in the fauna of southern California. Perhaps the intermixture results from southward range extensions of northern species inhabiting areas of upwelling.

On the other hand, many of the Amphipoda of Monterey Bay were not collected in the survey of Baja California (Barnard, 1964a). Thirty-seven open-sea samples were collected there, an effort comparable to that of Monterey Bay. A comparison of Monterey Bay and Baja California probably suffers the effects of small numbers of samples more than would a comparison between a large and a small number. The sampling stations of Baja California were scattered throughout 300 km of the coastal length and occurred in a variety of environments. Approximately 113 species occur in the fauna of Monterey Bay and Baja California, but only 61 species occur in both areas. The remaining species are listed in groups of northern and southern species in tables 7 and 8.

These data provide an estimate of the northern or southern affinities of more than 100 of the 167 species of Amphipoda occurring on the benthos of southern California. A large share of the species occurs in all three areas. Records from the literature supply information for some of the other Amphipoda, and a few species are assigned to regions by determining the general distribution of their genera. Facts and approximations are combined in a checklist of species from southern California (table 9). Only those species with detectable affinities are annotated with appropriate statements. The southern California fauna is estimated to be comprised of 24 percent northern or cold-water species, 13 percent southern or warm-water species, 5 percent bathyal affinity, and 58 percent interregional or poorly known distribution. Northern species occur generally in deep water, southern species in shallow water, and ubiquitous species in one or

both. The percentages support the conclusion that southern California lies at the northern end of the warm-temperate province but that the deep-water shelf is inhabited primarily by submergent cold-temperate species.

Presumably 16 species of table 8, marked with asterisks, represent northeastern Pacific endemic boreal elements which may be found throughout the Oregon province (in shallow depths in the northern portion). Approximately 28 (35 percent) of the 81 known species of Monterey Bay are of cold-temperate distribution. Purely tropical influence is small. The remaining species are of presumed warm-temperate affinities.

The intertidal zone of California north of Point Conception has several cold-temperate species (Barnard, MS), whereas the middepths of Monterey Bay and southern California have very few, if any, of these elements. These facts indicate that amphipodan distributions are strongly controlled by temperature and that a wide latitude of ecothermic response is possible for mud-bottom species through submergence because of substrate similarities between shallow and deep waters. The floral substrates of intertidal waters have a narrow range of submergence owing to the absence of illumination in deep waters. Thus phycophilous Amphipoda cannot submerge to the extent of their mud-bottom congeners. The thermal tolerances of the cold-temperate intertidal species must therefore be greater than those of mud dwellers. The temporal evolution of these intertidal distributions may be favorably controlled by the occurrence of a wide variety of available niches and an extensive food supply.

Northwestern Pacific Relationships

Only 12 of the 81 species of Monterey Bay have been found in the northwestern Pacific region embracing the Japan Sea, Okhotsk Sea, and Bering Sea (table 10). Two of those species, *Argissa hamatipes* and *Nicippe tumida*, may be cosmopolitan in cold water. They may submerge to great depths in the tropics, the former possibly occurring even in shallow tropical seas. *Leucothoe spinicarpa* is a eurybathic cosmopolite occurring in sponges. The genus *Anonyx* is enormously diverse in the northwestern Pacific region but declines in diversity by southerly increments. Only 2 species of *Anonyx* occur in California, south of Monterey Bay. *Corophium uenoi* rarely occurs in the open sea of California, but it is abundant in lagoons and estuaries (Newport Bay, Morro Bay) and may have been introduced from Japan in oyster transplants. The remaining 7 species of table 10, with the exception of *Ampelisca macrocephala* and *Paraphoxus obtusidens*, are scarce on the Monterey shelf. Probably they submerge or are depleted to the south of southern California. *Ampelisca macrocephala*

is an extremely abundant deep-shelf species in California and is replaced in bathyal depths by its anoculate subspecies, *A. m. unsocalae*. *Paraphoxus obtusidens* is a paneastern Pacific eurythermal species ranging from the subarctic into the tropics. It scarcely submerges to the south, but it may occur in warm latitudes primarily in areas of upwelling.

TABLE 1.—Metric depths of stations in Monterey Bay shown in figure 1 (uncorrected for tidal levels).

Station	Depth	Station	Depth	Station	Depth
6425	24	6444	17	6459	84
6426	54	6445	25	6460	87
6427	63	6446	52	6462	85
6428	61	6447	63	6463	87
6429	73	6448	55	6464	82
6430	78	6449	35	6465	93
6431	93	6450	34	6466	106
6432	98	6451	56	6469	109
6433	107	6452	53	6471	139
6435	116	6453	24	6474	115
6438	97	6454	15	6477	107
6439	67	6455	76	6478	101
6440	19	6456	77	6479	96
6442	24	6457	75	6480	103
6443	38	6458	80		

TABLE 2.—Frequency of 58 species of Amphipoda in Monterey Bay in depths of 50–139 m, with percent of restriction of each species to this depth zone (third species, based on 33 samples, eliminated in all calculations described in text; NSS = not statistically significant).

Name of species	Individuals per m²	Percent of specimens collected between 50 and 139 m	Present in no. of samples
Paraphoxus fatigans	73	76	18
(kind 1)	(13)	(39)	(6)
(kind 2)	(61)	(94)	(17)
Paraphoxus bicuspidatus	24	100	17
Kermystheus ociosa NSS	14	100	4
Phoxocephalus homilis	13	100	6
Photis lacia	12	100	8
Paraphoxus similis	12	87	12
Photis californica	11	100	2
Ampelisca macrocephala	10	96	19
Heterophoxus oculatus	9.7	95	15
Byblis veleronis	9.6	100	22
Ampelisca romigi	8.8	100	2
Metaphoxus frequens	7.3	80	15
Paraphoxus obtusidens	4.4	94	10
Ampelisca compressa	4.1	100	10
Paraphoxus variatus	3.9	60	4
Aoroides columbiae	3.6	27	6
Ampelisca cristata	3.2	70	7
Synchelidium sp. A	2.9	100	9

TABLE 2.—Frequency of 58 species of Amphipoda in Monterey Bay in depths of 50–139 m, with percent of restriction of each species to this depth zone (third species, based on 33 samples, eliminated in all calculation described in text; NSS=not statistically significant)—Continued

Name of species	Individuals per m²	Percent of specimens collected between 50 and 139 m	Present in no. of samples
Anonyx adoxus	2. 7	100	1
Urothoe varvarini	2. 6	100	4
Protomedeia articulata	2. 4	73	9
Lysianassa oculata	2. 3	100	9
Hippomedon denticulatus	2. 1	88	6
Synchelidium sp. G	2. 1	82	6
Ampelisca pacifica	2. 0	100	6
Ampelisca pugetica	2. 0	21	7
Monoculodes emarginatus	2. 0	100	6
Paraphoxus robustus	2. 0	100	6
Listriella goleta	1. 8	92	10
Orchomene pacifica	1. 7	100	2
Nicippe tumida	1. 5	100	5
Pardisynopia synopiae	1. 5	100	3
Dexamonica reduncans	1. 4	100	3
Orchomene decipiens	1. 4	100	4
Westwoodilla caecula	1. 2	100	6
Ampelisca hancocki	1. 1	100	4
Photis brevipes	1. 1	6	4
Opisa tridentata	0. 9	100	2
Melita desdichada	0. 8	100	2
Ampelisca brevisimulata	0. 6	100	3
Metaphoxus fultoni	0. 6	50	1
Paraphoxus epistomus	0. 6	100	1
Ampelisca milleri	0. 5	100	1
Acidostoma hancocki	0. 3	100	1
Lysianassa holmesi	0. 3	100	2
Centromedon pavor	0. 3	100	1
Lepidepecreum gurjanovae	0. 3	100	2
Maera danae	0. 3	100	1
Pachynus barnardi	0. 3	100	1
Prachynella lodo	0. 3	100	2
Synchelidium shoemakeri	0. 3	100	1
Anonyx carinatus	0. 2	100	1
Argissa hamatipes	0. 2	100	1
Microdeutopus schmitti	0. 2	0+	1
Photis macrotica	0. 2	100	1
Protomedeia penates	0. 2	100	1
Stenothoe frecanda	0. 2	100	1
Synchelidium sp. E	0. 2	100	1

Other species from Monterey Bay found in shallow water: *Ampelisca lobata, Amphilochus picadurus, Bathymedon roquedo, Corophium uenoi, Eohaustorius sencillus, Erichthonius brasiliensis, Eurystheus thompsoni, Ischyrocerus litotes, Leucothoe alata, Leucothoe spinicarpa, Liljeborgia kinahani, Listriella diffusa, Maera simile, Meguluropus longimerus, Megamphopus mamolus, Metopella aporpis, Monoculodes norvegicus, Monoculodes spinipes, Panoploea rickettsi, Parapleustes pugettensis, Photis bifurcata, Podocerus cristatus, Tiron biocellata.*

TABLE 3.—The most abundant species in depths of 39–55 m in southern California.

Species	Individuals per m²	Species	Individuals per m²
Ampelisca brevisimulata	68	*Listriella goleta*	14
Heterophoxus oculatus	58	*Paraphoxus obtusidens*	14
Paraphoxus bicuspidatus	44	*Ampelisca pacifica*	14
Amphideutopus oculatus	41	*Paraphoxus epistomus*	14
Paraphoxus similis	36	*Ampelisca pugetica*	11
Metaphoxus frequens	33	*Ampelisca compressa*	11
Ampelisca cristata	32	*Byblis veleronis*	8. 0
Photis brevipes	19	*Lysianassa oculata*	7. 7
Photis californica	19	*Podocerus cristatus*	7. 3
Photis lacia	17	*Paraphoxus stenodes*	7. 0

TABLE 4.—The most abundant species in depths of 57–73 m in southern California.

Species	Individuals per m²	Species	Individuals per m²
Paraphoxus bicuspidatus	134	*Amphideutopus oculatus*	12
Ampelisca brevisimulata	63	*Ampelisca indentata*	11
Heterophoxus oculatus	51	*Photis lacia*	11
Paraphoxus similis	45	*Ampelisca cristata*	9. 8
Metaphoxus frequens	35	*Lysianassa oculata*	9. 6
Ampelisca pacifica	31	*Ampelisca macrocephala*	9. 0
Ampelisca pugetica	21	*Nicippe tumida*	8. 8
Byblis veleronis	15	*Urothoe varvarini*	8. 6
Photis brevipes	15	*Paraphoxus robustus*	8. 3
Protomedeia articulata	13	*Lysianassa holmesi*	7. 4

TABLE 5.—The most abundant species in depths of 75–92 m in southern California.

Species	Individuals per m²	Species	Individuals per m²
Paraphoxus bicuspidatus	125	*Photis lacia*	24
Metaphoxus frequens	35	*Byblis veleronis*	15
Ampelisca macrocephala	34	*Lysianassa holmesi*	11
Ampelisca pacifica	33	*Photis californica*	11
Ampelisca brevisimulata	31	*Lysianassa oculata*	11
Heterophoxus oculatus	27	*Paraphoxus obtusidens*	10
Ampelisca pugetica	26	*Phoxocephalus homilis*	10
Paraphoxus similis	25	*Ampelisca hancocki*	8. 6
Paraphoxus robustus	25	*Pardisynopia synopiae*	8. 6
Urothoe varvarini	25	*Nicippe tumida*	8. 3

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TABLE 6.—The most abundant species in depths of 94–183 m in southern California.

Species	Individuals per m²	Species	Individuals per m²
Paraphoxus bicuspidatus	98	*Orchomene decipiens*	12
Ampelisca macrocephala	84	*Nicippe tumida*	11
Ampelisca romigi	45	*Ampelisca pugetica*	10
Heterophoxus oculatus	35	*Protomedeia articulata*	9. 6
Metaphoxus frequens	33	*Lysianassa holmesi*	9. 2
Photis lacia	27	*Paraphoxus similis*	8. 6
Ampelisca pacifica	21	*Paraphoxus robustus*	8. 3
Phoxocephalus homilis	19	*Urothoe varvarini*	8. 1
Westwoodilla caecula	16	*Pardisynopia synopiae*	7. 1
Ampelisca brevisimulata	13	*Lysianassa oculata*	6. 5

TABLE 7.—Amphipoda of Baja California not recorded from Monterey Bay (species marked with asterisks probably occur in both areas but were absent in the collections).

Acuminodeutopus heteruropus
Ampelisca indentata
Ampelisca mexicana
Ampelisca shoemakeri
Ampelisca venetiensis
Amphideutopus oculatus
Ampithoe ramondi
Cheiriphotis megacheles
Chevalia aviculae
Elasmopus antennatus
Eusiroides monoculoides
Gaviota podophthalma
Gitana calitemplado
**Listriella albina*
**Listriella eriopisa*
**Listriella melanica*
Lembos audbettius
Lysianassa dissimilis
Megaluropus ?agilis
Megamphopus effrenus (intertidal N of Point Conception)
Megamphopus martesia (intertidal N of Point Conception)
**Melphisana bola*
Metopa dawsoni
Monoculodes hartmanae
Ocosingo borlus (intertidal N of Point Conception)
Orchomene magdalenensis
Paraphoxus stenodes
Photis viuda
Platyischnopus metagracilis
Platyischnopus viscana
Podocerus brasiliensis
Pontogeneia quinsana
Pseudokoroga rima
Rudilemboides stenopropodus
Stenopleustes monocuspis
Stenothoides bicoma

TABLE 8.—Amphipoda of Monterey Bay not recorded from coastal shelf of Baja California; some species may occur on the slope in depths exceeding 100 m (asterisks mark possible northeastern Pacific cold-temperate species of the coastal shelf).

Anonyx adoxus
**Anonyx carinatus*
**Centromedon pavor*
Corophium uenoi
**Dexamonica reduncans*
**Eohaustorius sencillus*
**Kermystheus ociosa*
**Lepidepecreum gurjanovae*
**Lysianassa holmesi*
**Lysianassa oculata*
**Megamphopus mamolus*
Monoculodes norvegicus
**Monoculodes spinipes*
**Opisa tridentata*
Orchomene pacifica
**Paraphoxus similis*
**Parapleustes pugettensis*
**Photis lacia*
**Stenothoe frecanda*
**Protomedeia penates*
Urothoe varvarini

TABLE 9.—Benthic Amphipoda of the coastal shelf of southern California in depth classes of 9–18, 19–37, 38–55, 56–73, 74–92, and 93–183 m, from a survey of 348 samples (occurrences of the species in the surveys of Monterey Bay and Baja California are shown; other significant records are listed for various species, and the presumed affinities where significant, are stated).

Name of species	Monterey	Baja California	Literature records	Probable affinity	Southern California metric depth class
Acidostoma hancocki	x	sp. x		Northern	18–183
Acuminodeutopus heteruropus		x		Southern	18–92
Allorchestes angustus			Oregon	Northern	18
Ampelisca brevisimulata	x	x			18–183
Ampelisca compressa	x	x			18–183
Ampelisca cristata	x	x			18–183
Ampelisca furcigera			Okhotsk, Bering	Northern	183
Ampelisca hancocki	x	x			18–183
Ampelisca indentata		x		Southern	37–92
Ampelisca lobata	x	x			18–92
Ampelisca macrocephala	x	x	Cold-temperate	Northern	18–183
Ampelisca milleri	x	x			37–183
Ampelisca pacifica	x	x			18–183
Ampelisca pugetica	x	x			18–183
Ampelisca romigi	x	x			37–183
Amphideutopus oculatus		x		Southern	18–183
Amphilochus neapolitanus		x	Tropicopolitan	Southern	18
Amphilochus picadurus		x			18–37
Ampithoe plumulosa					18
Ampithoe simulans			Oregon	Northern	18
Anonyx carinatus	x			Northern	55–183
Aoroides columbiae	x	x			18–183
Argissa hamatipes		x			18–183
Atylus tridens			British Columbia	Northern	18
Batea transversa				Southern	18–37
Bathymedon pumilus				Bathyal	73–183
Bathymedon roquedo				Bathyal	92–183
Bruzelia tuberculata			Cold-temperate	Northern	183
Byblis veleronis	x	x			37–183
Ceradocus spinicaudus			Oregon	Northern	18
Cerapus tubularis		x			18–55
Cheiriphotis megacheles		x	Tropicopolitan	Southern	18
Chevalia aviculae		x	Tropicopolitan	Southern	18
Corophium acherusicum					18

TABLE 9.—Benthic Amphipoda of the coastal shelf of southern California in depth classes of 9–18, 19–37, 38–55, 56–73, 74–92, and 93–183 m, from a survey of 348 samples (occurrences of the species in the surveys of Monterey Bay and Baja California are shown; other significant records are listed for various species, and the presumed affinities where significant, are stated)—Continued

Name of species	Monterey	Baja California	Literature records	Probable affinity	Southern California metric depth class
Corophium baconi		x			18–55
Corophium uenoi	x		Japan	Northern	18
Dexamonica reduncans	x			Northern	55–183
Dulichia monacantha			Cold-temperate	Northern	92
Elasmopus antennatus		x			18–73
Eohaustorius sencillus	x			Northern	18
Eohaustorius washingtonianus				Northern	18–37
Ericthonius brasiliensis	x	x			18–183
Ericthonius hunteri			Cold-temperate	Northern	73–183
Eurystheus thompsoni	x	x			18–183
Garosyrrhoe bigarra					55
Gaviota podophthalma		x		Southern	18–73
Gitana calitemplado		x			18–55
Gitanopsis vilordes					18
Haploops spinosa			Cold-temperate	Northern	183
Harpiniopsis epistomata				Bathyal	92–183
Harpiniopsis fulgens				Bathyal	183
Harpiniopsis galera				Bathyal	92–183
Heterophlias seclusus			American tropical	Southern	18
Heterophoxus oculatus	x	x			18–183
Hippomedon denticulatus	x	x	Cold-temperate	Northern	18–183
Hyale rubra frequens					18
Ischyrocerus litotes	x	x			18–183
Ischyrocerus pelagops		x			18–37
Jassa falcata					18
Kermystheus ociosa	x				37–183
Lembos audbettius		x		Southern	55–92
Lembos concavus				Southern	18
Lepidepecreum garthi				Northern	92–183
Lepidepecreum gurjanovae	x			Northern	18–183
Leucothoe alata	x	x			18
Leucothoe spinicarpa	x	x			18–183
Leucothoides pacifica				Southern	18
Liljeborgia brevicornis				Northern	18
Listriella albina		x			18–183
Listriella diffusa	x	x			18–92
Listriella eriopisa		x			18–183
Listriella goleta	x	x			18–183
Listriella melanica		x			18–183
Lysianassa dissimilis		x			18
Lysianassa holmesi	x				18–183
Lysianassa oculata	x				18–183
Maera danae	x		Cold-temperate	Northern	183
Maera simile	x	x	Oregon	Northern	18–183
Mandibulophoxus uncirostratus			Indo-Pacific	Southern	18
Megaluropus longimerus	x	x			18–37
Megamphopus mamolus	x				18
Megamphopus martesia		x		Southern	18
Melita dentata			Cold-temperate	Northern	18
Melita desdichada	x	x			55, 183
Melphisana bola		x			18–73
Metaceradocus occidentalis				Southern	18–73
Metaphoxus frequens	x	x			18–183
Metaphoxus fultoni	x	x			18–183
Metopa dawsoni		x			55–183

TABLE 9.—Benthic Amphipoda of the coastal shelf of southern California in depths classes of 9–18, 19–37, 38–55, 56–73, 74–92, and 93–183 m, from a survey of 348 samples (occurrences of the species in the surveys of Monterey Bay and Baja California are shown; other significant records are listed for various species, and the presumed affinities where significant, are stated)—Continued

Name of species	Monterey	Baja California	Literature records	Probable affinity	Southern California metric depth class
Metopella aporpis	x	x			92–183
Microdeutopus schmitti	x	x			18–55
Monoculodes emarginatus	x	x			55–183
Monoculodes hartmanae		x			18–183
Monoculodes murrius					18–92
Monoculodes norvegicus	x		Cold-temperate	Northern	37–183
Najna ?consiliorum			Japan Sea	Northern	18
Neomegamphopus roosevelti			Baja California	Southern	18
Netamelita cortada					18
Nicippe tumida	x	x		Bathyal	37–183
Ocosingo borlus		x			"Shallow"
Opisa tridentata	x			Northern	18–183
Orchomene anaquela					37–92
Orchomene decipiens	x	x(sp.)			18–183
Orchomene magdalenensis		x		Southern	18
Orchomene pacifica	x		Northwest Pacific	Northern	55–183
Pachynus barnardi	x	x			18–183
Panaploea rickettsi	x	x			183
Parajassa angularis					18
Parametopella ninis					18–183
Paraphoxus abronius					18–92
Paraphoxus bicuspidatus	x	x			18–183
Paraphoxus cognatus					Pelagic
Paraphoxus daboius					18–183
Paraphoxus epistomus	x	x			18–183
Paraphoxus fatigans	x	x			18–183
Paraphoxus floridanus			Florida	Southern	18–55
Paraphoxus heterocuspidatus					18–55
Paraphoxus jonesi					18
Paraphoxus lucubrans					18–92
Paraphoxus obtusidens	x	x			18–183
Paraphoxus oculatus			Cold-temperate	Northern	183
Paraphoxus robustus	x	x			18–183
Paraphoxus similis	x				18–183
Paraphoxus spinosus					18–183
Paraphoxus stenodes		x			18–92
Paraphoxus tridentatus					18–37
Paraphoxus variatus	x	x			18–92
Parapleustes oculatus				Northern	183
Parapleustes pugettensis					18–183
Pardaliscella symmetrica				Bathyal	92–183
Pardisynopia synopiae	x	x		Bathyal	55–183
Photis bifurcata	x	x			18–92
Photis brevipes	x	x			18–183
Photis californica	x	x			18–92
Photis lacia	x			Northern	18–183
Photis macrotica	x	x			55–183
Phoxocephalus homilis	x	x			73–183
Platyischnopus viscana		x	Baja California	Southern	18
Pleustes platypa			Rare So. Calif.	Northern	18
Podocerus brasiliensis		x	Tropicopolitan	Southern	18
Podocerus cristatus	x	x			18–183
Polycheria antarctica					18
Pontogeneia rostrata			Northwest Pacific	Northern	18
Prachynella lodo	x	x			37–183

TABLE 9.—Benthic Amphipoda of the coastal shelf of southern California in depths classes of 9–18, 19–37, 38–55, 56–73, 74–92, and 93–183 m, from a survey of 348 samples (occurrences of the species in the surveys of Monterey Bay and Baja California are shown; other significant records are listed for various species, and the presumed affinities where significant, are stated)—Continued

Name of species	Monterey	Baja California	Literature records	Probable affinity	Southern California metric depth class
Protomedeia articulata	x	x		Northern	18–183
Pseudokoroga rima		x		Southern	18
Rhachotropis inflata			Cold-temperate	Northern	183
Rhachotropis oculata	x		Cold-temperate	Northern	73–183
Rudilemboides stenopropodus					18–73
Schisturella cocula				Bathyal	183
Socarnes illudens		x		Northern	183
Stenopleustes monocuspis		x		Southern	73–183
Stenothoe frecanda	x				55–183
Stenothoides bicoma		x			18–183
Stenula modosa					73–183
Sympleustes subglaber			Genus northern	Northern	18–183
Synchelidium rectipalmum					18–183
Synchelidium shoemakeri	x				18–183
Synchelidium sp. A	x				18–183
Synchelidium sp. E	x				18–183
Synchelidium sp. G	x				18–183
Tiron biocellata	x	x			18–183
Uristes entalladurus			Baja California		18
Urothoe varvarini	x		North Pacific	Northern	37–183
Westwoodilla caecula	x	x	Cold-temperate	Northern	18–183

TABLE 10.—Amphipoda of Monterey Bay recorded from the northwestern Pacific Ocean.

Depths of 15–49 m	Depths of 50–139 m
Corophium uenoi	*Ampelisca macrocephala*
Leucothoe spinicarpa	*Argissa hamatipes*
Monoculodes norvegicus	*Hippomedon denticulatus*
	Maera danae
	Nicippe tumida
	Orchomene pacifica
	Paraphoxus obtusidens
	Westwoodilla caecula
	Urothoe varvarini

Family Acanthonotozomatidae

Panoploea rickettsi Shoemaker

Panoploea rickettsi Shoemaker, 1931, pp. 1–5, figs. 1, 2.—Barnard, 1964a, p. 212.

Material: 6425 (1).

Distribution: Monterey Bay to San Quintin Bay, Baja California, 10–92 m.

Family Ampeliscidae

Ampelisca brevisimulata Barnard

Ampelisca brevisimulata Barnard, 1954a, pp. 33–35, pls. 23, 24; 1964a, p. 212.

Material: 6433 (1), 6435 (2), 6471 (1).

Distribution: Caribbean Sea and eastern Pacific Ocean from Panama to Monterey Bay, 11–172 m.

Ampelisca compressa Holmes

Ampelisca compressa.—Barnard, 1960a, pp. 31–32; 1964a, p. 213.

Material: 6427 (1), 6428 (4), 6429 (2), 6430 (3), 6435 (1), 6447 (9), 6448 (2), 6451 (1), 6452 (2), 6471 (2).

Distribution: Western Atlantic Ocean, Caribbean Sea, eastern Pacific Ocean from Panama to Puget Sound, Washington, 1–266 m.

Ampelisca cristata Holmes

Ampelisca cristata.—Barnard, 1954a, pp. 26–28, pls. 17, 18; 1964a, p. 213.

Material: 6426 (3), 6427 (7), 6428 (1), 6429 (5), 6430 (2), 6446 (1), 6447 (2), 6449 (2), 6450 (1), 6453 (5).

Distribution: Caribbean Sea and eastern Pacific Ocean from Ecuador to Tomales Bay, California, 6–152 m.

Ampelisca hancocki Barnard

Ampelisca hancocki Barnard, 1954a, pp. 37–38, pl. 26; 1964a, p. 213.

Material: 6433 (1), 6451 (1), 6465 (1), 6471 (2), 6474 (2).

Distribution: Eastern Pacific Ocean from Monterey Bay to Costa Rica, 9–157 m.

Ampelisca lobata Holmes

FIGURE 2*a*

Ampelisca lobata.—Barnard, 1954a, pp. 11–14, pls. 5, 6; 1964a, p. 214.

Material: 6425 (24).

Distribution: Caribbean Sea, eastern Pacific Ocean from Ecuador and the Galapagos Islands to Monterey Bay, 0–183 m.

Ampelisca macrocephala (Liljeborg)

Ampelisca macrocephala.—Barnard 1954a, pp. 41–43, pl. 29; 1960a, pp. 28–30, fig. 7; 1964a, p. 214.

Material: 6426 (1), 6427 (2), 6428 (1), 6430 (3), 6431 (2), 6432 (4), 6433 (9), 6435 (14), 6438 (2), 6443 (2), 6446 (2), 6450 (1), 6451 (1), 6455 (2), 6460 (1), 6464 (3), 6465 (1), 6466 (3), 6470 (4), 6471 (12), 6478 (1).

Distribution: Subarctic-boreal in the North Atlantic and North Pacific Oceans, submerging in waters of low latitudes, 5–1686 m.

Ampelisca milleri Barnard

Ampelisca milleri Barnard, 1954a, pp. 9–11, pls. 3, 4; 1964a, p. 215.

Material: 6474 (3).

Distribution: Eastern Pacific Ocean from Ecuador and the Galapagos Islands to San Francisco Bay, California, 15–187 m in the open sea, from shallow water in San Francisco Bay.

Ampelisca pacifica Holmes

Ampelisca pacifica.—Barnard 1954a, pp. 31–33, pls. 21, 22; 1964a, p. 215.

Material: 6432 (3), 6458 (4), 6466 (2), 6471 (2), 6477 (1), 6478 (1).

Distribution: Caribbean Sea, eastern Pacific Ocean from Panama to Monterey Bay, California, 24–183 m.

Ampelisca pugetica Stimpson

Ampelisca pugetica.—Barnard 1954a, pp. 49–51, pls. 35, 36; 1960a, p. 31, fig. 9; 1964a, p. 215.

Material: 6425 (46), 6426 (1), 6427 (3), 6428 (2), 6430 (2), 6447 (3), 6452 (1), 6463 (1).

Distribution: Caribbean Sea, eastern Pacific Ocean from Peru to Puget Sound, Washington, 9–183 m.

Ampelisca romigi Barnard

Ampelisca romigi Barnard, 1954a, pp. 18–20, pls. 10, 11; 1960a, p. 34; 1964a, pp. 215–216.

Material: 6471 (10), 6474 (48).

Distribution: Caribbean Sea, eastern Pacific Ocean from Ecuador to Monterey Bay, 3–504 m.

Byblis veleronis Barnard

Byblis velcronis Barnard, 1954a, pp. 52–54, pls. 37, 38; 1964a, p. 216.

Material: 6426 (1), 6428 (3), 6429 (2), 6430 (4), 6431 (2), 6432 (8), 6433 (2), 6435 (2), 6438 (2), 6447 (1), 6451 (5), 6452 (3), 6455 (4), 6458 (2), 6462 (1), 6464 (2), 6465 (1), 6466 (6), 6470 (2), 6471 (3), 6474 (6), 6480 (1).

Distribution: Monterey Bay to the Gulf of California, 31–422 m.

Family Amphilochidae

Amphilochus picadurus Barnard

Amphilochus picadurus Barnard, 1962c, pp. 126–129, fig. 4; 1964a, p. 217.

Material: 6425 (4).

Distribution: Monterey Bay to southern California, 33° N., 4–41 m.

Family Aoridae

Aoroides columbiae Walker

Aoroides columbiae Barnard, 1961, p. 180; 1964a, pp. 217–218.

Material: 6425 (57), 6432 (2), 6433 (2), 6435 (2), 6440 (1), 6445 (8), 6470 (1), 6471 (6), 6474 (11).

Distribution: Puget Sound, Washington to San Quintin Bay, Baja California, 0–180 m.

Microdeutopus schmitti Shoemaker

Microdeutopus schmitti Shoemaker, 1942, pp. 18–21, fig. 6; 1959a, pp. 32–33, pl. 9; 1961, p. 180; 1964a, p. 218.

Material: 6425 (419), 6425 (1).

Distribution: Monterey Bay to Cape San Lucas, Baja California, 0–43 (65?) m.

Family Corophiidae

Corophium uenoi Stephensen

Corophium uenoi Stephensen, 1932, pp. 494–498, figs. 3, 4.—Barnard, 1952, pp. 28–32, pls. 8, 9; 1959a, p. 39.—Nagata, 1960, p. 178.—Barnard, 1961, p. 183; 1964b, p. 112, chart 16.

Material: 6425 (3).

Distribution: Japan; eastern Pacific Ocean from Monterey Bay at 24 m depth, to San Quintin Bay, Baja California, rarely occurring in the open sea, more often in lagoons or estuaries such as Morro Bay, Newport Bay, and San Quintin Bay, intertidal to 2 m.

Ericthonius brasiliensis (Dana)

Ericthonius brasiliensis.—Barnard 1955a, pp. 37–38; 1959a, p. 39; 1961, p. 183; 1964a, p. 219.

Material: 6425 (69), 6445 (2).

Distribution: Cosmopolitan in tropical, warm-temperate and some boreal seas, 0–130 m.

Family Dexaminidae

Dexamonica reduncans Barnard

Dexamonica reduncans Barnard, 1958, pp. 130–132, pls. 26, 27.

Material: 6433 (2), 6471 (6), 6474 (1).

Distribution: Monterey Bay to southern California, 33° N, in Monterey Bay from 107 to 139 m in depth, in southern California from about 55 to 183 m.

219–939—66——3

Family Eusiridae

Rhachotropis oculata (Hansen)

FIGURES 2*b–f*

Rhachotropis oculata.—Stephensen, 1944, pp. 97–98.—Gurjanova, 1951, pp. 712–713, fig. 496.

Stebbing (1906) stated that the rostrum of this species is small. Although the heads of the specimens at hand resemble Hansen's figure reproduced by Gurjanova (1951), the rostra are long and hidden from lateral view by the first antennae. Article 3 of antenna 1 is not as short as or indistinct as that described by Stebbing or figured by Hansen. Small specimens, difficult to separate from *R. inflata* Sars, may be distinguished by the produced corner of the second pleonal epimeron.

Material: Hancock *Velero* stations 1027 (2), 1149 (4), 4753 (1), 4772 (1), 4824 (1), 5615 (1), 5760 (1), 6001 (1), 6006 (1).

Records: Coastal shelf of southern California and Santa Catalina Island, 64–274 m, caught in benthic grabs and dredges, probably a demersal species infrequently collected in benthic closing devices.

Distribution: North Atlantic and North Pacific Oceans, Bering Sea, Okhotsk Sea, Japan Sea, 20–274 m. These are the southernmost records of this species in the eastern Pacific Ocean.

Family Gammaridae

Maera danae (Stimpson)

Maera danae.—Shoemaker, 1955, pp. 53–54 (with references).—Barnard, 1964b, pp. 108–109.
Maera loveni.—J. L. Barnard, 1962b, p. 103, fig. 19 (not Bruzelius).

Material: 6462 (2), 85 m.

Additional record: 4770 (1), southern California, 33°21′ N., 117°34′ W., 15 m.

Remarks: According to Shoemaker (1955) this species lacks an articulated spine at the palmar defining corner of gnathopod 2, but a spine is present on the specimens at hand, yet the second articles of pereopods 3–5 are broad, not slender as in *M. loveni*, and distinct eyes are present. Regardless of the gnathopodal spine, the specimens are identified as *M. danae*.

Distribution: North Atlantic and North Pacific Oceans, in the North Pacific known as far south as San Quintin Bay in shallow water but primarily a subarctic species submerging with depth toward the tropics, rather rare in southern California and usually occurring in depths of about 200 m.

Maera simile Stout

Maera simile.—Barnard, 1959a, pp. 24–25, pl. 4; 1964a, p. 222.

Material: 6425 (1).

Distribution: Coos Bay, Oregon to San Quintin Bay, Baja California, 0–43 m.

Megaluropus longimerus Schellenberg

Megaluropus longimerus.—Barnard, 1962b, p. 103, figs. 20, 21; 1964a, p. 224.

Material: 6440 (3), 6442 (3).

Distribution: Lagos, Nigeria; in the eastern Pacific Ocean from Monterey Bay to San Ramon Bay, Baja California, 10–108 m.

Melita desdichada Barnard

Melita desdichada Barnard, 1962b, p. 110, fig. 22; 1964a, p. 224.

Material: 6455 (4), 6460 (1).

Distribution: Monterey Bay to San Ramon Bay, Baja California, 10–108 m.

Family Haustoriidae

Eohaustorius sencillus Barnard

Eohaustorius sencillus Barnard, 1962f, pp. 249–252, figs. 1, 2.

Material: 6444 (19), 6445 (1), 6454 (28).

Distribution: Monterey Bay to Point Conception, California, 14–25 m.

Urothoe varvarini Gurjanova

Urothoe varvarini Gurjanova, 1953, pp. 219–221, figs. 3, 4.—Barnard, 1957, pp. 82–84.—Gurjanova, 1962, pp. 426–428, fig. 142.

Material: 6433 (1), 6438 (1), 6471 (6), 6474 (9).

Distribution: Northwestern Pacific Ocean, Japan Sea, Okhotsk Sea, 5–13 m; California from Monterey Bay to southern California at 33° N, 40–200+ m.

Family Isaeidae (=Photidae)

Eurystheus thompsoni (Walker)

Eurystheus thompsoni.—Barnard, 1959a, p. 36; 1961, p. 182; 1964a, p. 237.

Material: 6425 (44), 6445 (1).

Distribution: Puget Sound, Washington to Magdalena Bay, Baja California, 0–135 m.

Kermystheus ociosa Barnard

Kermystheus ociosa Barnard, 1962a, p. 23, fig. 8.

Material: 6432 (2), 6435 (2), 6471 (7), 6474 (81).

Distribution: Monterey Bay to the coastal shelf of southern California between Point Conception and San Diego, 27–165 m.

Megamphopus mamolus Barnard

Megamphopus mamolus Barnard, 1962a, pp. 23–26, fig. 9.

Material: 6425 (68), 6445 (9).

Distribution: Monterey Bay to Point Conception, California, at the latter in a red algal *Diopatra* bed, 16 m; at Monterey in depths of 24–25 m.

Photis bifurcata Barnard

Photis bifurcata Barnard, 1962a, pp. 30–31, fig. 10; 1964a, p. 240.

Material: 6425 (332), 6445 (15).

Distribution: Monterey Bay to San Cristobal Bay, Baja California, 11–93 m.

Photis brevipes Shoemaker

Photis brevipes Shoemaker, 1942, pp. 25–27, fig. 9.—Barnard, 1962a, pp. 31–33, fig. 11; 1964a, pp. 240–241.

Material: 6425 (58), 6445 (7), 6471 (2), 6477 (5).

Distribution: Coos Bay, Oregon to Magdalena Bay, Baja California, 0–135 m.

Photis californica Stout

Photis californica.—Barnard, 1962a, pp. 33–36, figs. 12, 13; 1964a, p. 241.

Material: 6471 (12), 6474 (58).

Distribution: Monterey Bay to San Cristobal Bay, Baja California, 10–98 m, in southern California; maximum depth in Monterey Bay 139 m.

Photis lacia Barnard

Photis lacia Barnard, 1962a, pp. 42–44, fig. 18.

Material: 6425 (4), 6430 (?2), 6432 (2), 6433 (9), 6465 (1), 6469 (3), 6471 (34), 6474 (24), 6477 (2).

Distribution: Monterey Bay to southern California, 32° N, 9–146 m, abundant on the shelf in depths of 73–92 m (38 individuals per m^2).

Photis macrotica Barnard

Photis macrotica Barnard, 1962a, p. 44, fig. 19; 1964a, p. 241.

Material: 6474 (1).

Distribution: Monterey Bay to San Cristobal Bay, Baja California, 55–157 m.

Protomedeia articulata Barnard

Protomedeia articulata Barnard, 1962a, pp. 48–50, fig. 21; 1964a, p. 242.

Material: 6426 (1), 6429 (1), 6438 (1), 6445 (6), 6455 (6), 6456 (1), 6457 (2), 6458 (2), 6466 (1), 6471 (?1).

Distribution: Monterey Bay to San Quintin Bay, Baja California, 18–200+ m.

Protomedeia penates, new species

FIGURE 3

Diagnosis of male: Article 2 of gnathopod 1 lacking posterodistal swelling; article 7 of gnathopod 1 overlapping palm by more than 75 percent of its length, palm with triangular process and defined by one stout spine; palm of gnathopod 2 with defining tooth exceeding transverse palm and bearing small basal tooth anterior to it; inner ramus of uropod 3 slightly shorter than outer ramus.

Female: Gnathopods with oblique palms defined by large spines.

Notes: Article 2 of pereopod 5 has a small dorsoposterior tooth; pleonal epimeron 3 bears lateral setae, variable in extent and often absent, especially in males.

Holotype: Allan Hancock Foundation no. 5923, male 6.0 mm.

Type locality: White Gulch, Tomales Bay, California, sta. 1–59–10, June 29, 1959, depth of 48 feet, on dark sand and mud, associated with *Chone* and *Pectinaria*, collected by Dr. Joel W. Hedgpeth and Dr. Ralph G. Johnson, 8 specimens.

Material: 6455 (4).

Relationship: Morphologically, this species is most closely related to *Protomedeia fasciatoides* Bulycheva (1952) but differs in having a longer palmar tooth of male gnathopod 2 and oblique palms on the female gnathopods. The absence of a posterodistal prominence on article 2 of gnathopod 1 distinguishes *P. penates* from *P. fasciata* Krøyer (Sars, 1895, pl. 196), a species having a distinctive aspect as illustrated by Gurjanova (1951). The largest male, 7.0 mm, from station 6455, is obviously fully mature and lacks the gnathopodal prominence. *Protomedeia popovi* Gurjanova (1951) is also similar to *P. penates*, but the male has a more oblique gnathopodal palm lacking the subsidiary palmar tooth.

Distribution: Tomales Bay to Monterey Bay, California, 15–76 m.

Family Ischyroceridae

Ischyrocerus litotes (Barnard)

Ischyrocerus litotes—Barnard, 1962a, pp. 53–56, figs. 23, 24; 1964a, pp. 226–227.

Material: 6425 (1).

Remarks: I may have been in error in removing this species from its original position in *Microjassa* because of the slight difference in size of coxae 5 and 6. As in *Microjassa*, coxa 1 of this species is small in contrast to members of *Ischyrocerus*. Both genera probably should be emended to permit *I. litotes* to be included with

Microjassa. *Ischyrocerus litotes* at least forms a bridge between the two concepts. Its small size, very shiny, slick body, and poor pigment in alcohol make it highly distinctive from other species of *Ischyrocerus*.

Distribution: Monterey Bay to San Cristobal Bay, Baja California, 1–157 m.

Family Leucothidae

Leucothoe alàta Barnard

Leucothoe alata Barnard, 1959a, pp. 19–20, pl. 1; 1962c, p. 132, figs. 7, D, E, F; 1964a, p. 227.

Material: 6425 (5).

Distribution: Monterey Bay to San Ramon Bay, Baja California, 0–24 m.

Leucothoe spinicarpa (Abildgaard)

Leucothoe spinicarpa—Sars, 1895, p. 100, pl. 101, fig. 1—Barnard, 1962c, p. 132, figs. 7, A, B, C; 1964a, p. 227.

Material: 6425 (2).

Distribution: Cosmopolitan, 0–1505 m.

Family Liljeborgiidae

Liljeborgia kinahani (Bate)

Liljeborgia kinahani.—Sars, 1895, pp. 532–533, pl. 188, fig. 1.—Chevreux and Fage, 1925, p. 157, fig. 157.—Barnard, 1964a, p. 228.

Material: 6425 (5).

Distribution: Possibly bipolar, rare in southern California, in the eastern Pacific Ocean known as far south as off San Quintin Bay, Baja California, 24–41 m.

Listriella diffusa Barnard

Listriella diffusa Barnard, 1959b, pp. 18–20, figs. 3–5; 1964a, p. 228.

Material: 6440 (1).

Distribution: Monterey Bay to San Cristobal Bay, Baja California, 12–172 m.

Listriella goleta Barnard

Listriella goleta Barnard, 1959b, pp. 20–22, figs. 5–7; 1964a, p. 229.

Material: 6427 (1), 6428 (2), 6429 (1), 6431 (1), 6446 (1), 6448 (1), 6450 (1), 6451 (2), 6466 (1), 6477 (1), 6480 (1).

Distribution: Monterey Bay to San Cristobal Bay, Baja California, 12–200+ m.

Family Lysianassidae

Acidostoma hancocki Hurley

Acidostoma hancocki Hurley, 1963, pp. 37–40, figs. 9, 10.

Material: 6429 (2).

Distribution: Monterey Bay to southern California, 33° N, 22–73 m.

Anonyx adoxus Hurley

FIGURE 4

Anonyx adoxus Hurley, 1963, pp. 108–112, figs. 35, 36.

Diagnosis: Eyes dark, rather small for genus, forming an elongated oval of even dimensions, not expanded at either end; epistome and upper lip not differentially produced; coxa 1 rounded ventrally; gnathopod 1 with article 6 concave posteriorly, narrowing distally, palm short, coarsely serrate, dactyl strongly overlapping palm; palm of gnathopod 2 short, slightly produced, dactyl short, fitting palm perfectly; pereopods 1 and 2 with hooked, unstriated spine at base of article 7; all pereopods with large spines on sixth articles; inner ramus of uropod 2 not abnormally shortened, bearing small constriction on dorsal margin; rami of uropod 3 subequal in length, article 2 of outer ramus very small (see figure); first pleonal epimeron differing on the two sides of the adult specimen, on the left side with the anterior edge straight, on the right side produced anteriorly (see figures); second pleonal epimeron with rounded anteroventral corner, posterior corner with small, blunt tooth; third pleonal epimeron rounded at anteroventral corner, posterior corner with moderately slender, medium-sized tooth; body lacking sculpture or minute ornamentation.

Material: 6432, female, 10.0 mm, and 17 hatched juveniles.

Remarks: This adult specimen has the special characteristics noted by Hurley in his key (1963, p. 103), but it differs slightly in the configuration of its epistome-labrum complex, the accessory flagellum is shorter, and marginal spines are absent from the telsonic lobes. The weakly hooked, blunt distal spines of the sixth articles on pereopods 1–2 are small, as shown by Hurley. However, the minute ornamentation of the spines has the appearance of the large spines of the *A. liljeborgi* group of the genus.

Anonyx adoxus most closely resembles *Anonyx nugax* (Phipps) and its varieties as arranged by Gurjanova (1962), but the eyes of *A. adoxus* are not differentially widened. The following species, references to which may be found in Gurjanova (1962), differ from the specimen at hand in the morphology of the parts and appendages listed: *A. liljeborgi*, upper lip and uropod 2, third pleonal epimeron; *A. affinis*, *A. minimus*, uropods 2 and 3; *A. validus*, third pleonal

epimeron; *A. kurilicus*, *A. magnus*, uropod 2; *A. ampulloides*, *A. laticoxae*, uropod 2 and eyes; *A. ochoticus*, eyes and epistome; *A. compactus* and *A. oculatus*, eyes and spines of pereopods 1 and 2.

Distribution: Monterey Bay (type locality), 18–98 m.

Anonyx carinatus (Holmes)

Lakota carinata Holmes, 1908, pp. 498–500, fig. 9.—Gurjanova, 1962, pp. 302–303, fig. 100.

Anonyx carinatus.—Hurley, 1963, pp. 103–108.

Material: 6477 (1).

Distribution: Monterey Bay to southern California, 33° N., 69–200 m.

Centromedon pavor, new species

FIGURE 5

Diagnosis: Lateral cephalic lobes short, rounded terminally, separated from large rostral area by deep concavity; antenna 1 very stout, articles 2 and 3 short, telescoped into article 1, article 1 of flagellum heavily armed with aesthetes; coxa 5 with well-defined posterior lobe; urosomite 1 bulbous dorsally.

Holotype: Allan Hancock Foundation no. 5922, female, 2.9 mm.

Type locality: Station 6459, Monterey Bay, California, 84 m, September 1959.

Material: Two specimens from the type locality and 6462 (1), 6477 (1).

Relationship: The genus *Centromedon* became monotypic when Barnard (1962d) removed all but its type species to the genus *Uristes*. *Centromedon pumilus* (Liljeborg) differs from *C. pavor* in having very acute, projecting lateral cephalic lobes, slender first antennae, a symmetrically lobed fifth coxa, and a poorly ornamented first urosomite. As the specimens at hand and that figured by Sars are females, these differences cannot be attributed to sexual dimorphism. The mouthparts of *C. pavor* correspond to those figured for *C. pumilus* by Sars (1895, pl. 34, fig. 2).

Hippomedon denticulatus (Bate)

Hippomedon denticulatus.—Hurley, 1963, pp. 137–140, fig. 45.—Barnard, 1964a, p. 230; 1964b, pp. 80–82.

Material: 6426 (1), 6430 (1), 6445 (2), 6447 (1), 6471 (4), 6474 (2), 6477 (5).

Distribution: Subarctic-boreal of North Atlantic and North Pacific Oceans, 0–924 m; in the eastern Pacific its southern record is off San Cristobal Bay, Baja California.

Lepidepecreum gurjanovae Hurley

Lepidepecreum gurjanovae Hurley, 1963, pp. 49–53, figs. 13, 14.

Material: 6469 (1), 6474 (1).

Distribution: In the northeastern Pacific Ocean from about 33° N to about 49° N, 109–1740 m.

Lysianassa holmesi (Barnard), new combination

Aruga holmesi Barnard, 1955b, p. 100, pls. 27, 28.—Gurjanova, 1962, pp. 299–301, figs. 98, 99.
Lysianopsis holmesi.—Hurley, 1963, pp. 74–75, fig. 21b.

Material: 6431 (1), 6474 (1).

Distribution: Monterey Bay to Ecuador, 1–183 m.

Remarks: I am carrying Hurley's synthesis of various lysianassid genera one more step by fusing *Lysianopsis* Holmes, along with *Aruga* Holmes, *Shoemakerella* Pirlot, *Arugella* Pirlot, and *Pronannonyx* Schellenberg to *Lysianassa*. This procedure is discussed in another paper (Barnard, MS).

Lysianassa oculata (Holmes), new combination

Aruga oculata Holmes, 1908, pp. 505–507, figs. 14, 15.—Barnard, 1955b, p. 98, pl. 29, figs. a-f,h,j.—Gurjanova, 1962, pp. 294–296, fig. 96.
Lysianopsis oculata.—Hurley, 1963, p. 74, fig. 21c.

Material: 6426 (1), 6428 (1), 6429 (1), 6431 (6), 6438 (1), 6439 (1), 6448 (1), 6451 (2), 6455 (1).

Distribution: Monterey Bay to southern California, 32° N, 18 to ?300 m, generally shallower than 100 m.

Opisa tridentata Hurley

Opisa tridentata Hurley, 1963, pp. 26–30, figs. 4, 5.

Material: 6435 (1), 6471 (3), 6474 (2).

Distribution: Monterey Bay to southern California, 33° N, 44–183 m.

Orchomene decipiens Hurley, new combination

Orchomenella decipiens Hurley, 1963, pp. 127–130, figs. 43, 44.
Orchomene species.—Barnard, 1964a, p. 231.

Material: 6435 (1), 6471 (5), 6474 (2), 6477 (1).

Distribution: Monterey Bay to San Cristobal Bay, Baja California, 35–180 m.

Remarks: Barnard (1964b) synonymized *Orchomenella* Sars with *Orchomene* Boeck.

Orchomene pacifica (Gurjanova)

Orchomenella pacifica Gurjanova, 1938, pp. 252–254, fig. 3; 1951, p. 287, fig. 155; 1962, pp. 174–177, figs. 52, 53.
Orchomene pacifica.—Barnard, 1964b, pp. 92–93, fig. 13.

Material: 6471 (7), 6474 (4).

Distribution: Northwestern Pacific Ocean, Japan Sea, Okhotsk Sea, 29–129 m; California from Monterey Bay to southern California, 33° N, 46–183 m.

Pachynus barnardi Hurley

Pachynus barnardi Hurley, 1963, pp. 31–35, figs. 6, 7.
Pachynus species, Barnard, 1964a, p. 232.

Material: 6458 (1), 6469 (1).

Distribution: Monterey Bay to San Ramon Bay, Baja California, 12–183 m.

Prachynella lodo Barnard

Prachynella lodo Barnard, 1964a, p. 233, fig. 7.

Material: 6426 (1), 6471 (1).

Distribution: Monterey Bay to San Cristobal Bay, Baja California, 10–157 m.

Family Oedicerotidae

Monoculodes emarginatus Barnard

Monoculodes emarginatus Barnard, 1962e, pp. 361–363, fig. 4; 1964a, p. 234.

Material: 6432 (2), 6435 (2), 6438 (1), 6466 (3), 6469 (1), 6471 (4).

Distribution: Monterey Bay to San Quintin Bay, Baja California, 55–200+ m.

Monoculodes norvegicus (Boeck)

Monoculodes norvegicus.—Sars, 1895, pp. 301–302, pl. 107, fig. 1.—Barnard, 1962e, p. 367 (with references).

Material: 6425 (1).

Distribution: Subarctic-boreal in the North Atlantic and North Pacific Oceans, occurring in southern California as about 1.3 individuals per m^2 on the coastal shelf, in depths of 20–146 m.

Monoculodes spinipes Mills

Monoculodes spinipes Mills, 1962, pp. 12–14, fig. 3.—Barnard, 1962e, pp. 368–369, fig. 10.

Material: 6454 (1).

Distribution: British Columbia to Point Conception, California, intertidal to 20 m.

Synchelidium species A

A new species with vestigial rostrum, manuscript in preparation.

Material: 6427 (1), 6428 (1), 6429 (7), 6430 (2), 6431 (3), 6438 (2), 6465 (1), 6466 (1), 6474 (1).

Distribution: Monterey Bay to southern California, 32° N, 10–100+ m.

Synchelidium species E

A new species, manuscript in preparation.

Material: 6435 (1), 116 meters.

Distribution: Monterey Bay to southern Califronia, 32° N, about 40–183+ m.

Synchelidium species G

A new species, manuscript in preparation.

Material: 6435 (2), 6439 (4); varietal type: 6426 (2), 6427 (3), 6433 (2) 6440 (3), 6469 (1).

Distribution: Monterey Bay to southern California, 32° N, 10 to slightly more than 120 m.

Synchelidium shoemakeri Mills

Synchelidium shoemakeri Mills, 1962, pp. 15–17, figs. 4, 6A.

Material: 6432 (2), 98 m.

Distribution: British Columbia south to southern California, intertidal in northern end of its range, subtidal in southern California, to depths slightly exceeding 100 m but very rare below 40 m.

Westwoodilla caecula (Bate)

Westwoodilla caecula.—Mills, 1962, pp. 509, figs. 1, 6A.—Barnard, 1962e, p. 370; 1964a, p. 235.

Material: 6427 (1), 6431 (1), 6435 (3), 6438 (1), 6469 (1), 6474 (1).

Distribution: A cold-temperate species of the North Atlantic and North Pacific Oceans, in the eastern Pacific known as far south as Todos Santos Bay, Baja California; intertidal in British Columbia but occurring in southern California in 12–200 m.

Family Pardaliscidae

Nicippe tumida Bruzelius

Nicippe tumida.—Barnard, 1959c, pp. 39–40, figs. 1, 2; 1964a, p. 235.

Material: 6431 (2), 6433 (1), 6457 (1), 6465 (2), 6466 (4).

Distribution: Apparently cosmopolitan, submerging in the tropics, 34–1367 m.

Pardisynopia synopiae Barnard

Pardisynopia synopiae Barnard, 1962b, pp. 77–79, figs 3, 4; 1964a, pp. 235–236.

Material: 6431 (2), 6435 (2), 6438 (3), 6465 (1), 6469 (1), 6471 (1).

Distribution: Monterey Bay to San Quintin Bay, Baja California, 53–200+ m.

Family Phoxocephalidae

Heterophoxus oculatus (Holmes)

Heterophoxus oculatus.—Barnard, 1960b, pp. 320–324, pls. 59–61; 1964a, p. 242.

Material: 6425 (3), 6431 (2), 6432 (3), 6433 (2), 6455 (5), 6456 (1), 6457 (4), 6458 (5), 6459 (1), 6462 (1), 6464 (8), 6465 (8), 6471 (1), 6474 (8), 6477 (13), 6480 (1).

Distribution: Puget Sound, Washington to Panama, 13–1785 m; in San Quintin Bay, Baja California, 2 m.

Metaphoxus frequens Barnard

Metaphoxus frequens Barnard, 1960b, pp. 304–306, pls, 51, 52; 1964a, p. 242.

Material: 6425 (12), 6426 (1), 6428 (4), 6429 (2), 6430 (4), 6431 (1), 6432 (5), 6433 (12), 6435 (6), 6438 (3), 6458 (1), 6466 (2), 6470 (2), 6471 (3), 6477 (1), 6480 (1).

Distribution: Monterey Bay to Isabel Island, Mexico, 13–458 m.

Metaphoxus fultoni (Scott)

Metaphoxus fultoni.—Chevreux and Fage, 1925, pp. 106–107, figs. 96, 97.—Barnard, 1964a, pp. 242–243.

Material: 6425 (4), 6474 (4).

Distribution: Eastern Atlantic Ocean and Mediterranean Sea, from England to Tunisia; in the eastern Pacific Ocean from Monterey Bay to San Cristobal Bay, Baja California, 0–170 m.

Paraphoxus bicuspidatus Barnard

Paraphoxus bicuspidatus Barnard, 1960b, pp. 218–221, pls. 15, 16; 1964a, p. 243, fig. 12.

Material: 6430 (8), 6431 (21), 6432 (22), 6433 (23), 6435 (13), 6438 (13), 6447 (2), 6448 (6), 6451 (13), 6452 (12), 6455 (4), 6456 (2), 6457 (1), 6458 (5), 6466 (7), 6469 (4), 6471 (5).

Distribution: Monterey Bay to Santa Maria Bay, Baja California, 8–210 m.

Paraphoxus epistomus (Shoemaker)

Paraphoxus epistomus.—Barnard, 1960b, pp. 205–209, pls. 6–8; 1964a, p. 243.

Material: 6429 (4).

Distribution: Mendocino County in northern California to Panama, 0–182 m; northwestern Atlantic Ocean from New Hampshire to South Carolina.

Paraphoxus fatigans Barnard

FIGURES 6, 7

Paraphoxus fatigans Barnard, 1960b, pp. 209–210, pl. 9; Barnard, 1964a, p. 244.

Material: Kind 1: 6426 (48), 6427 (14), 6428 (1), 6429 (3), 6440 (5), 6442 (17), 6443 (18), 6444 (6), 6445 (32), 6446 (18), 6448 (1), 6449 (7), 6450 (6), 6453 (2), 6454 (40). Kind 2: 6427 (38), 6428 (33), 6429 (54), 6430 (60), 6431 (30), 6432 (14), 6433 (23), 6435 (11), 6438 (24), 6445 (2), 6446 (8), 6447 (26), 6448 (41), 6449 (4), 6451 (6), 6452 (4), 6453 (18), 6466 (25), 6469 (1), 6471 (1).

Remarks: The most common members of *Paraphoxus* in Monterey Bay are the most difficult to identify. These specimens have several characters which are intermediate between those of *P. fatigans* and *P. daboius* (both Barnard, 1960b). Two kinds of fifth pereopods

occur which resemble the figures of *P. fatigans* published by Barnard. The first gnathopods of *P. fatigans* are slender, those of *P. daboius* strongly expanded and those of the specimens at hand are intermediate between the two species. The two species and the specimens at hand have small female eyes. The epistomal cusp is usually longer than it is in either *P. fatigans* or *P. daboius*.

The two configurations of pereopod 5 are: Article 2 has more than 3 very small teeth crowded together on the posterior margin, the oblique ventral edge being slightly convex rather than truncate as in *P. fatigans* from southern California (figs. 6*d*,*k*,*l*); article 2 has only 2 or 3 slightly enlarged, less crowded teeth, the oblique ventral margin being nearly truncate (fig. 6*c*). A third kind of rare occurrence, is shown in figures 6*a*,*e*,*i*,*j*; the posterior teeth of article 2 are very large and resemble those of *P. variatus* Barnard (1960b).

Although the gnathopods of the specimens at hand are stouter than those of *P. variatus*, the enlarged teeth of pereopod 5 on some individuals demonstrate the close relationship of the *P. fatigans* complex with *P. variatus*. Barnard (1960b) has already considered the possibility that *P. fatigans* is a phenotype of *P. variatus*, but a clarification of the problem is complicated by the additional differences displayed by the specimens from Monterey Bay.

The Monterey *fatigans* complex resembles *Paraphoxus epistomus*, of which only a few specimens have been found in the present samples. *Paraphoxus epistomus* may be distinguished by the horizontal ventral edge (either truncate or slightly convex) of article 2 on pereopod 5 and by the slightly stouter gnathopods. A few specimens assigned to *P. fatigans* show a relationship to *P. epistomus* because of the peduncular setosity of uropod 2. Most of these specimens have the elongated epistomal process.

Distribution: Monterey Bay to Todos Santos Bay, Baja California, 12–162 m.

Paraphoxus obtusidens (Alderman)

Paraphoxus obtusidens.—Barnard, 1960b, pp. 249–259, pls. 33–37; 1964a, p. 244.

Material: 6429 (1), 6430 (1), 6431 (6), 6432 (3), 6433 (5), 6435 (1), 6438 (1), 6439 (1), 6444 (1), 6453 (1), 6469 (3), 6471 (5).

Distribution: Kurile Islands to Columbia, South America, 0–180 m.

Paraphoxus robustus Holmes

Paraphoxus robustus.—Barnard, 1960b, pp. 235–236, pl. 25; 1964a, p. 244.

Material: 6431 (1), 6432 (2), 6433 (4), 6466 (1), 6471 (1), 6474 (4).

Distribution: Puget Sound, Washington to San Quintin Bay, Baja California, 4–183 m.

Paraphoxus similis Barnard

Paraphoxus similis Barnard, 1960b, pp. 230–233, pls. 22, 23.

Material: 6431 (2), 6432 (6), 6438 (3), 6444 (11), 6456 (1), 6458 (11), 6459 (1), 6465 (10), 6466 (6), 6474 (17), 6477 (13), 6478 (4), 6480 (2).

Distribution: Puget Sound, Washington, to southern California, 32° N, 31–324 m, abundant on the shelf of southern California in depths of 55–110 m.

Paraphoxus variatus Barnard

Paraphoxus variatus Barnard, 1960b, pp. 198–202, pls. 3, 4; 1964a, p. 245.

Material: 6426 (14), 6428 (2), 6446 (2), 6447 (8), 6450 (17).

Distribution: Monterey Bay to San Ramon Bay, Baja California, 5–93 m.

Phoxocephalus homilis Barnard

Phoxocephalus homilis Barnard, 1960b, p. 301, pls. 49, 50; 1964a, p. 245.

Material: 6433 (1), 6456 (10), 6471 (12), 6474 (51), 6477 (9), 6480 (5).

Distribution: Monterey Bay to San Cristobal Bay, Baja California, 62–200+ m.

Family Pleustidae

Parapleustes pugettensis (Dana)

Parapleustes pugettensis.—Barnard and Given, 1960, pp. 43–45, fig. 4 (with synonymy).—Shoemaker, 1964, pp. 410–413, fig. 10.

Material: 6445 (1), 25 m.

Distribution: West coast of Alaska, 62° N to southern California, 32° N, where it is moderately abundant in the intertidal zone and on shallow water epifloras.

Family Podoceridae

Podocerus cristatus (Thomson)

Podocerus cristatus.—Barnard, 1962a, pp. 67–69, figs. 31, 32; 1964a, p. 246.

Material: 6425 (11).

Distribution: Probably cosmopolitan in the Indo-Pacific tropical and warm-temperate regions, southwest Africa, New Zealand, Hawaii, Australia, in the eastern Pacific Ocean from Monterey Bay to Turtle Bay, Baja California, 0–171 m.

Family Stenothoidae

Metopella aporpis Barnard

Metopella aporpis Barnard, 1962c, pp. 142–145, figs. 12, 13; 1964a, p. 246.

Material: 6425 (1), 24 m.

Distribution: Monterey Bay to San Cristobal Bay, Baja California, 24–140 m, south of Point Conception not shallower than 84 m.

Stenothoe frecanda Barnard

Stenothoe frecanda Barnard, 1962c, p. 151, fig. 18.

Material: 6471 (1)

Distribution: Monterey Bay to southern California shelf, 64–92 m.

Family Synopiidae (=Tironidae)

Tiron biocellata Barnard

Tiron biocellata Barnard, 1962b, p. 75, fig. 2; 1964a, p. 247.

Material: 6440 (1).

Distribution: Monterey Bay to San Cristobal Bay, Baja California, 11–180 m.

Literature Cited

ALDERMAN, A. L.

1936. Some new and little known amphipods of California. Univ. California Publ. Zoöl., vol. 41, pp. 53–74, figs. 1–51.

BARNARD, J. L.

1952. Some Amphipoda from central California. Wasmann Journ. Biol., vol. 10, pp. 9–36, pls. 1–9.

1954a. Amphipoda of the family Ampeliscidae collected in the eastern Pacific Ocean by the *Velero III* and *Velero IV*. Allan Hancock Pacific Exped., vol. 18, no. 1, 137 pp., pls. 1–38.

1954b. Marine Amphipoda of Oregon. Oregon State Monogr. Stud. Zool., no. 8, pp. 1–103, pls. 1–33, fig. 1.

1955a. Gammaridean Amphipoda (Crustacea) in the collections of Bishop Museum. Bernice P. Bishop Mus. Bull. 215, pp. 1–46, pls. 1–20.

1955b. Notes on the amphipod genus *Aruga* with the description of a new species. Bull. Southern California Acad. Sci., vol. 54, pp. 97–103, pls. 27–29.

1957. A new genus of haustoriid amphipod from the northeastern Pacific Ocean and the southern distribution of *Urothoe varvarini* Gurjanova. Bull. Southern California Acad. Sci., vol. 56, pp. 81–84, pl. 16.

1958. A new genus of dexaminid amphipod (marine Crustacea) from California. Bull. Southern California Acad. Sci., vol. 56, pp. 130–132, pls. 26, 27.

1959a. Estuarine Amphipoda. *In* Ecology of Amphipoda and Polychaeta of Newport Bay, California. Allan Hancock Found. Publ. Occas. Pap. 21, pp. 13–69, pls. 1–14.

1959b. Liljeborgiid amphipods of southern California coastal bottoms, with a revision of the family. Pacific Nat., vol. 1, no. 4, pp. 12–28, figs. 1–12.

1959c. The common pardaliscid Amphipoda of southern California, with a revision of the family. Pacific Nat., vol. 1, no. 12, pp. 36–43, figs. 1–4.

1960a. New bathyal and sublittoral ampeliscid amphipods from California, with an illustrated key to Ampelisca. Pacific Nat., vol. 1, no. 16, pp. 1–36, figs. 1–11.

1960b. The amphipod family Phoxocephalidae in the eastern Pacific Ocean, with analyses of other species and notes for a revision of the family. Allan Hancock Pacific Exped., vol. 18, no. 3, pp. 175–368, pls. 1–75.

1961. Relationship of California amphipod faunas in Newport Bay and in the open sea. Pacific Nat., vol. 2, no. 4, pp. 166–186, figs. 1–2.

1962a. Benthic marine Amphipoda of southern California: Families Aoridae, Photidae, Ischyroceridae, Corophiidae, Podoceridae. Pacific Nat. vol. 3, no. 1, pp. 1–72, figs. 1–32.

1962b. Benthic marine Amphipoda of southern California: Families Tironidae to Gammaridae. Pacific Nat., vol. 3, no. 2, pp. 73–115, figs. 1–23.

1962c. Benthic marine Amphipoda of southern California: Families Amphilochidae, Leucothoidae, Stenothoidae, Argissidae, Hyalidae. Pacific Nat., vol. 3, no. 3, pp. 116–163, figs. 1–23.

1962d. South Atlantic abyssal amphipods collected by R.V. *Vema*. *In* Abyssal Crustacea, Vema Res. Ser., no. 1, pp. 1–78, figs. 1–79.

1962e. Benthic marine Amphipoda of southern California: Family Oedicerotidae. Pacific Nat., vol. 3, no. 12, pp. 349–371, figs. 1–10.

1962f. A new species of sand-burrowing marine Amphipoda from California. Bull. Southern California Acad. Sci., vol. 61, pp. 249–252, figs. 1–2.

1963. Relationship of benthic Amphipoda to invertebrate communities of inshore sublittoral sands of southern California. Pacific Nat., vol. 3, no. 15, pp. 437–467, figs. 1–7.

1964a. Los anfipodos bentonicos marinos de la costa occidental de Baja California. Rev. Soc. Mexicana Hist. Nat., vol. 24, pp. 205–274, figs. 1–11.

1964b. Marine Amphipoda of Bahia de San Quintin, Baja California. Pacific Nat., vol. 4, no. 3, pp. 55–139, figs. 1–21.

In press. Intertidal Amphipoda of California: Monterey to La Jolla.

Barnard, J. L., and Given, R. R.

1960. Common pleustid amphipods of southern California, with a projected revision of the family. Pacific Nat., vol. 1, no. 17, pp. 37–48, figs. 1–6.

Barnard, J. L., and Jones, G. F.

1960. Techniques in a large scale survey of marine benthic biology. *In* Pearson, Waste disposal in the marine environment, pp. 413–447.

Barnard, J. L., and Ziesenhenne, F. C.

1961. Ophiuroid communities of southern Californian coastal bottoms. Pacific Nat., vol. 2, no. 2, pp. 131–152, figs. 1–8.

Bousfield, E. L.

1958. Notes on the amphipod genus *Orchestoidea* on the Pacific coast of North America. Bull. Southern California Acad. Sci., vol. 56, pp. 119–129, pls. 24, 25.

Bulycheva, A. I.

1952. Novye vidy bokoplavov (Amphipoda, Gammaridea) iz Japonskogo morja. Trudy Zool. Inst. Akad. Nauk SSSR, vol. 12, pp. 195–250, figs. 1–39. [In Russian.]

California Cooperative Fisheries Investigations

1952–64. California Cooperative Oceanic Fisheries Investigations Reports [California Marine Research Committee Progress Reports], vols. 9+.

Calman, W. T.

1898. On a collection of Crustacea from Puget Sound. Ann. New York Acad. Sci., vol. 11, pp. 259–292, pls. 31–34.

CHEVREUX, E., and FAGE, L.
1925. Amphipodes. Faune de France, vol. 9, pp. 1–488, figs. 1–438.

EKMAN, S.
1953. Zoogeography of the sea, pp. i–xiv + 1–417, figs. 1–121.

GARTH, J. S.
1955. The case for a warm-temperate marine fauna on the west coast of North America: Essays in the natural sciences in honor of Captain Allan Hancock, on the occasion of his birthday, July 26, 1955, pp. 19–27.

GURJANOVA, E. F.
1938. Amphipoda, Gammaroidea [sic] of Siaukhu Bay and Sudzukhe Bay (Japan Sea). *In* Reports of the Japan Sea Hydrobiological Expedition of the Zoological Institute of the Academy of Sciences of the USSR in 1934, pt. 1, pp. 241–404, figs. 1–59. [In Russian with English summary.]
1951. Bokoplavy morej SSSR i sopredel'nykh vod (Amphipoda-Gammaridea). Opredel. Faune SSSR Akad. Nauk SSSR, vol. 41, pp. 1–1029, figs. 1–705. [In Russian.]
1953. Novye dopolnenija k dal'nevostochnoi faune morskik bokoplavov. Trudy Zool. Inst. Akad. Nauk SSSR, vol. 13, pp. 216–241, figs. 1–19. [In Russian.]
1962. Bokoplavy severnoi chasti Tixogo Okeana (Amphipoda-Gammaridea) chast' 1. Opredel. Faune SSSR Akad. Nauk SSSR, vol. 74, pp. 1–440, figs. 1–143. [In Russian.]

HARTMAN, O.
1956. Contributions to a biological survey of Santa Monica Bay, California, 161 pp. [Mimeographed report to Hyperion Engineers Inc. by Geology Dept., Univ. Southern California, Los Angeles.]

HOLMES, S. J.
1908. The Amphipoda collected by the U.S. Bureau of Fisheries Steamer, *Albatross*, off the west coast of North America, in 1903 and 1904, with descriptions of a new family and several new genera and species. Proc. U.S. Nat. Mus., vol. 35, pp. 489–543, figs. 1–46.

HURLEY, D. E.
1963. Amphipoda of the family Lysianassidae from the west coast of North and Central America. Allan Hancock Found. Publ., Occas. Pap. no. 25, pp. 1–165, figs. 1–49.

JONES, G. F. and BARNARD, J. L.
1963. The distribution and abundance of the inarticulate brachiopod Glottidia albida (Hinds) on the mainland shelf of southern California. Pacific Nat., vol. 4, pp. 27–52, figs. 1–14.

MILLS, E. L.
1961. Amphipod crustaceans of the Pacific coast of Canada, 1: Family Atylidae. Nat. Mus. Canada Bull. 172, pp. 13–33, figs. 1–6.
1962. Amphipod crustaceans of the Pacific coast of Canada, 2: Family Oedicerotidae. Nat. Hist. Paps. Nat. Mus. Canada, vol. 15, pp. 1–21, figs. 1–6.

NAGATA, K.
1960. Preliminary notes on benthic gammaridean Amphipoda from the *Zostera* region of Mihara Bay, Seto Inland Sea, Japan. Publ. Seto Mar. Biol. Lab., vol. 8, pp. 163–182, figs. 1–2, pls. 13–17.

SARS, G. O.
1895. Amphipoda. Vol. 1 *of* An account of the Crustacea of Norway with short descriptions and figures of all the species, viii + 711 pp., 240 pls., 8 suppl. pls.

SHOEMAKER, C. R.
1925. The Amphipoda collected by the United States Fisheries Steamer *Albatross* in 1911, chiefly in the Gulf of California. Bull. American Mus. Nat. Hist., vol. 52, pp. 21–61, figs. 1–26.
1931. A new species of amphipod crustacean (Acanthonotozomatidae) from California, and notes on Eurystheus tenuicornis. Proc. U.S. Nat. Mus., vol. 78, pp. 1–8, figs. 1–4.
1942. Amphipod crustaceans collected on the presidential cruise of 1938. Smithsonian Misc. Coll., vol. 101, no. 11, pp. 1–52, figs. 1–17.
1955. Amphipoda collected at the arctic laboratory, Office of Naval Research, Point Barrow, Alaska, by G. E. Macginitie. Smithsonian Misc. Coll., vol. 128, no. 1, pp. 1–78, figs. 1–20.
1964. Seven new amphipods from the west coast of North America with notes on some unusual species. Proc. U.S. Nat. Mus., vol. 115, pp. 391–430, figs. 1–15.

STEBBING, T. R. R.
1906. Amphipoda, 1: Gammaridea. Pt. 21 *in* Das Tierreich, pp. 1–806, figs. 1–127.

STEPHENSEN, K.
1932. Some new amphipods from Japan. Annot. Zool. Japonensis, vol. 13, pp. 487–501, figs. 1–5.

THORSTEINSON, E. D.
1941. New or noteworthy amphipods from the North Pacific Coast. Univ. Washington Publ. Oceanogr., vol. 4, pp. 50–96, pls. 1–8.

THORSON, G.
1957. Bottom communities. Ch. 17 *in* vol. 1 *of* Hedgpeth et al., Treatise on marine ecology and paleoecology.

WALKER, A. O.
1898. Crustacea collected by W. A. Herdman, F.R.S., in Puget Sound, Pacific coast of North America, September 1897. Trans. Liverpool Biol. Soc., vol. 12, pp. 268–287, pls. 15, 16.

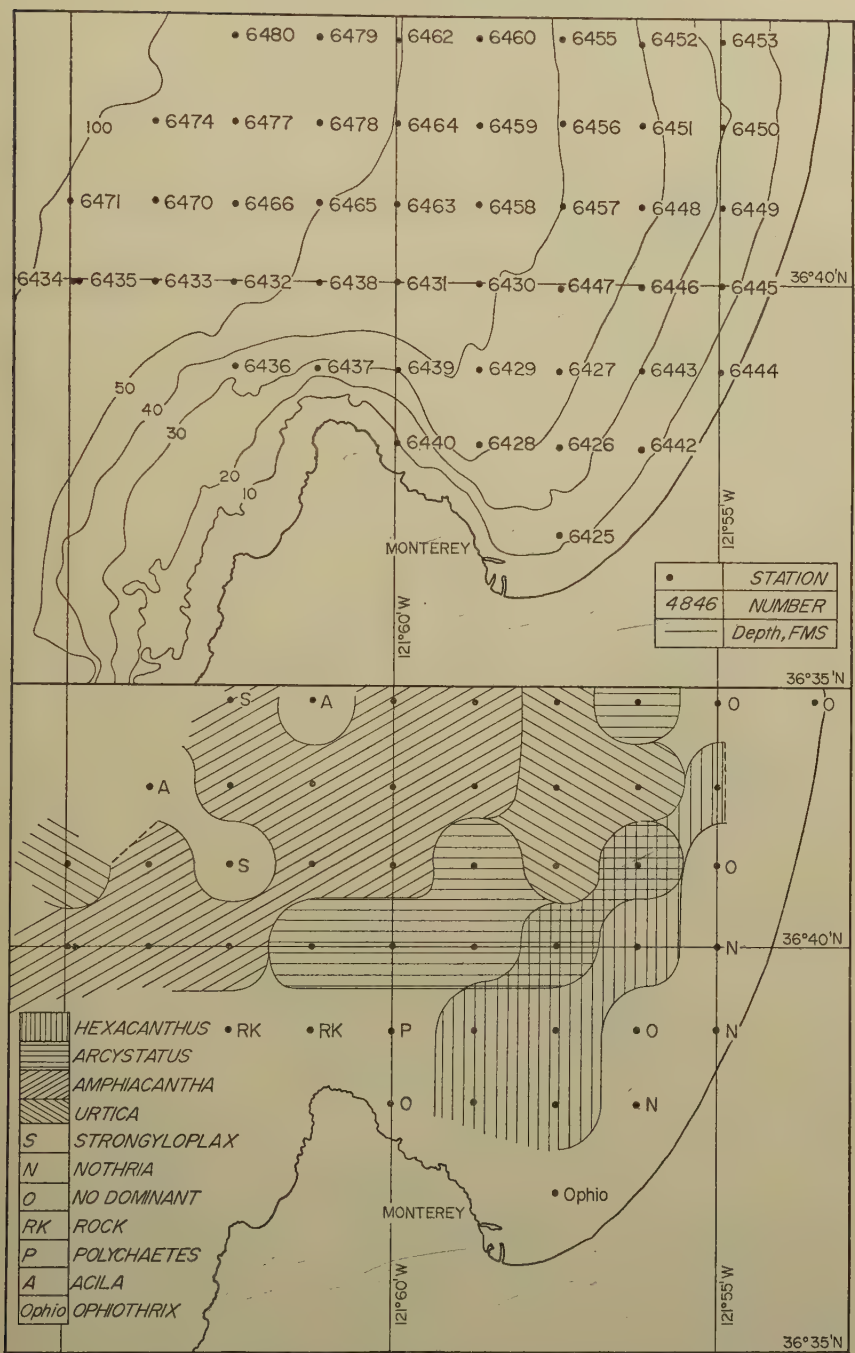

FIGURE 1.—Upper, station locations in Monterey Bay; lower, distribution of community dominants.

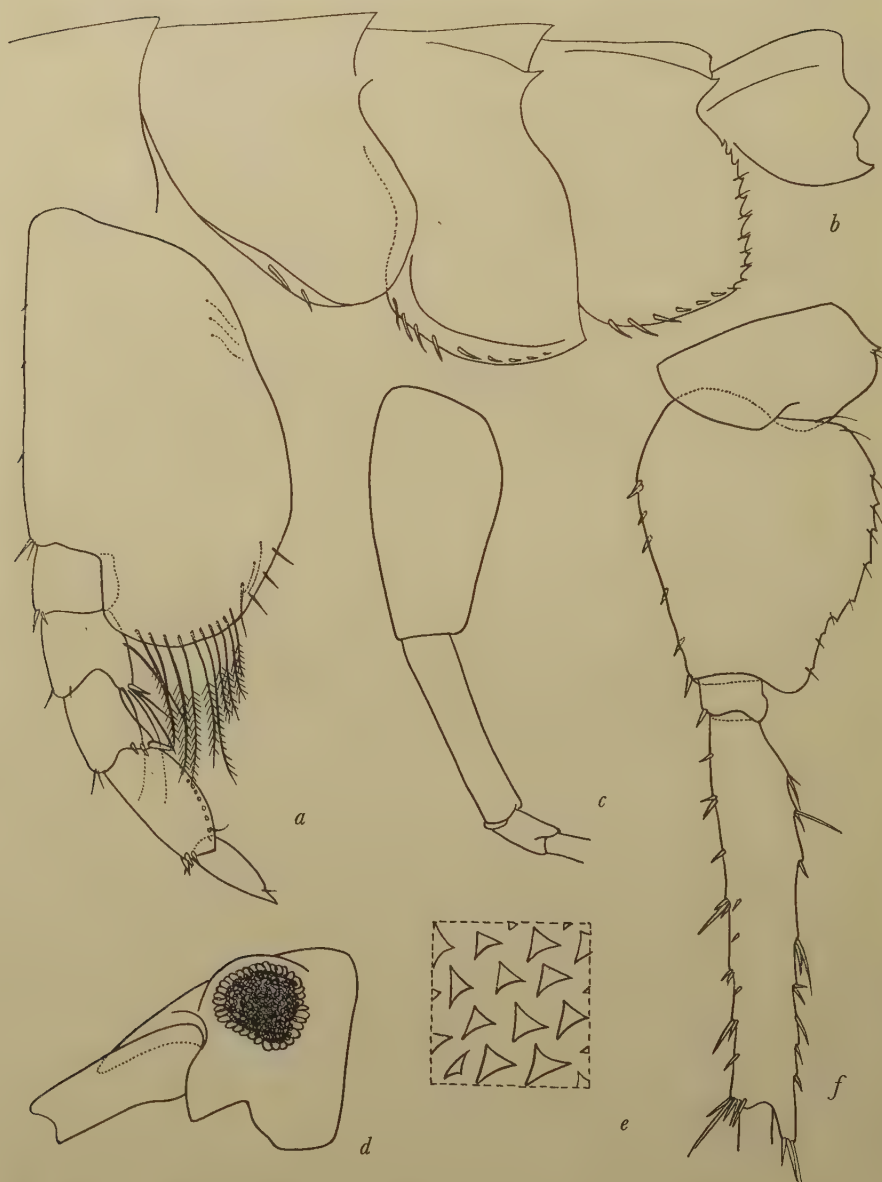

FIGURE 2.—*Ampelisca lobata* Holmes, female, 4.0 mm, sta. 6425: *a*, pereopod 5. *Rhachotropis oculata* (Hansen), male, 8.0 mm, sta. 1149 (southern California): *b*, dorsally toothed segments, left to right, pereonal 7, pleonal 1–4; *c*, peduncle of antenna 1; *d*, head; *e*, cuticular scales of chitin; *f*, pereopod 5.

FIGURE 3.—*Protomedeia penates*, new species, White Gulch, Tomales Bay, female, 7.0 mm: *a*, lateral view; *b*, antenna 1 to show accessory flagellum; *c*, article 5 of pereopod 4; *d–f*, uropods 1, 2, 3; *g*, telson; *h*, pleonal segment 2; *i*, base of peduncle of antenna 2; *j*, articles 2–3 of pereopod 5; *k,l*, gnathopods 1, 2; *m*, head; *n,o*, articles 6–7 of gnathopods 1, 2. Male, 6.0 mm: *p,q*, gnathopods 2, 1; *r,s*, palms of gnathopods 1, 2.

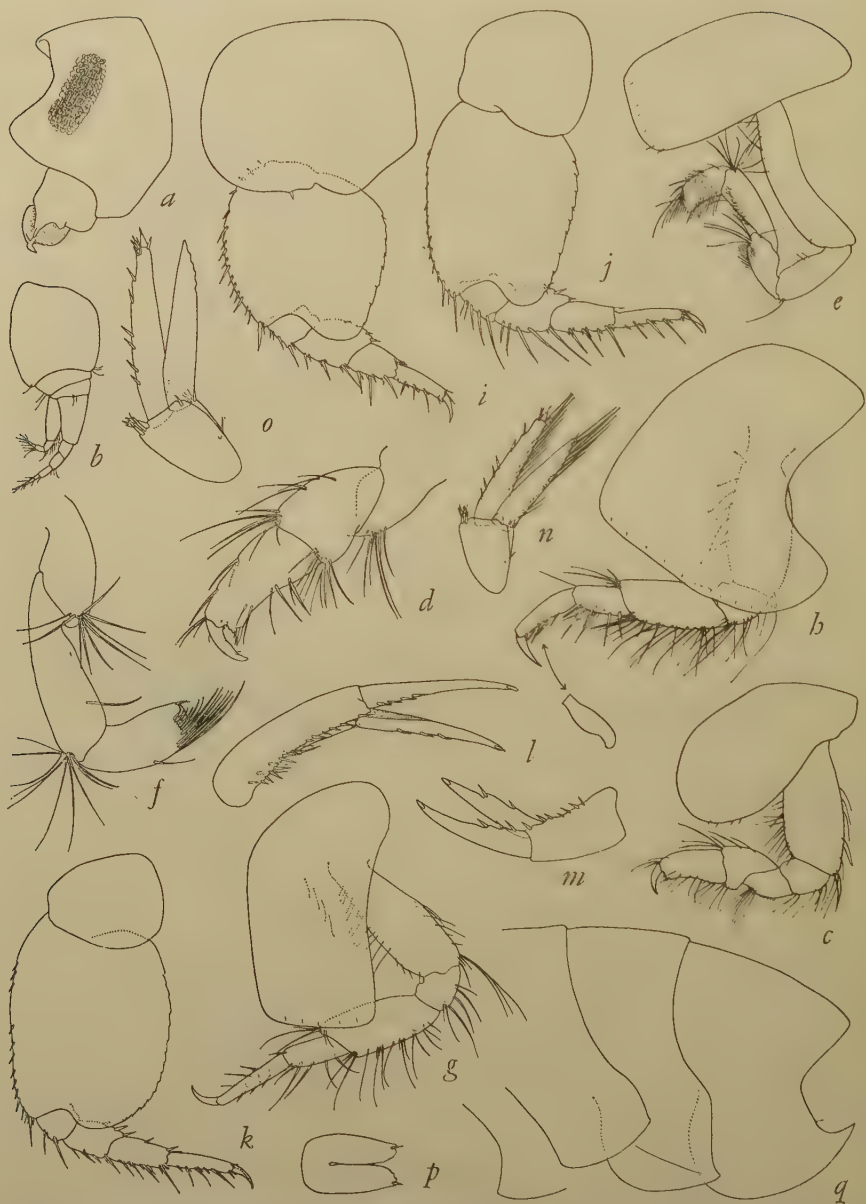

FIGURE 4.—*Anonyx adoxus* Hurley, female, 10.0 mm, sta. 6432: *a*, head; *b*, antenna 1; *c,d*, gnathopod 1; *e,f*, gnathopod 2; *g–k*, pereopods 1, 2, 3, 4, 5; *l,m*, uropods 1, 2; *n,o*, uropod 3 with and without setae; *p*, telson; *q*, pleonal epimera 1–3, left to right, right side of pleonal epimeron 1 offset.

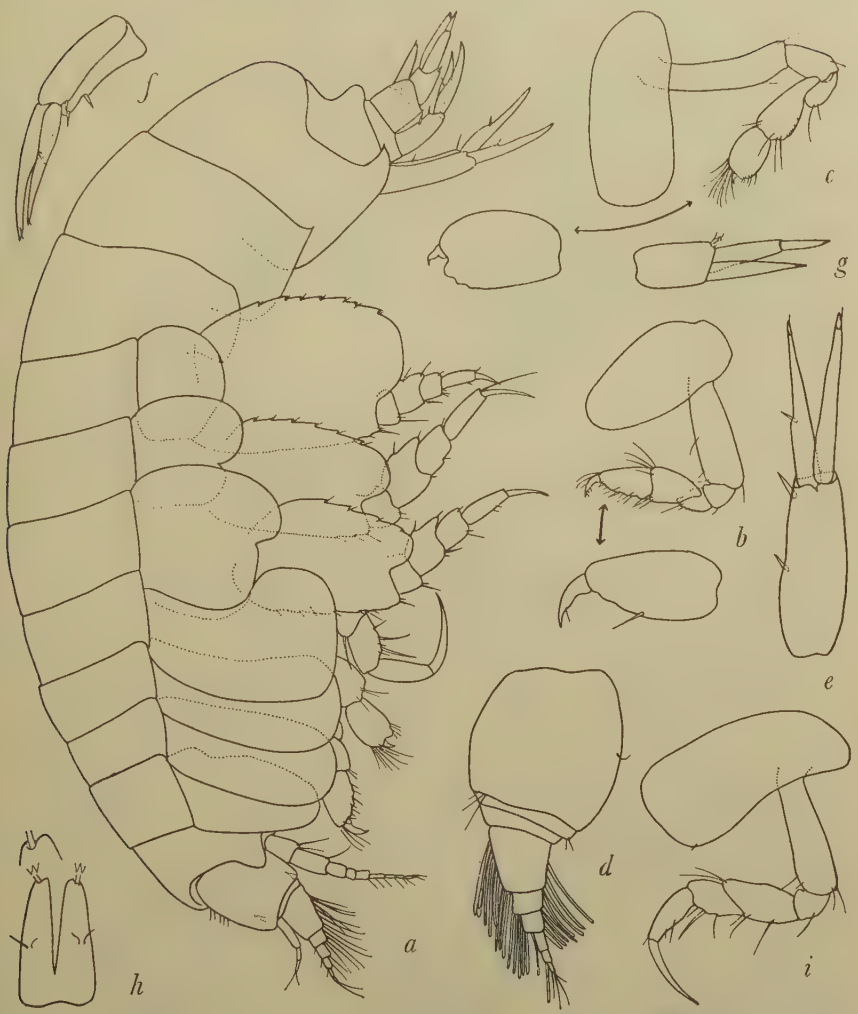

FIGURE 5.—*Centromedon pavor*, new species, holotype, female, 2.9 mm, sta. 6459: *a*, lateral view; *b*,*c*, gnathopods 1, 2; *d*, antenna 1; *e*–*g*, uropods 1, 2, 3; *h*, telson; *i*, pereopod 1.

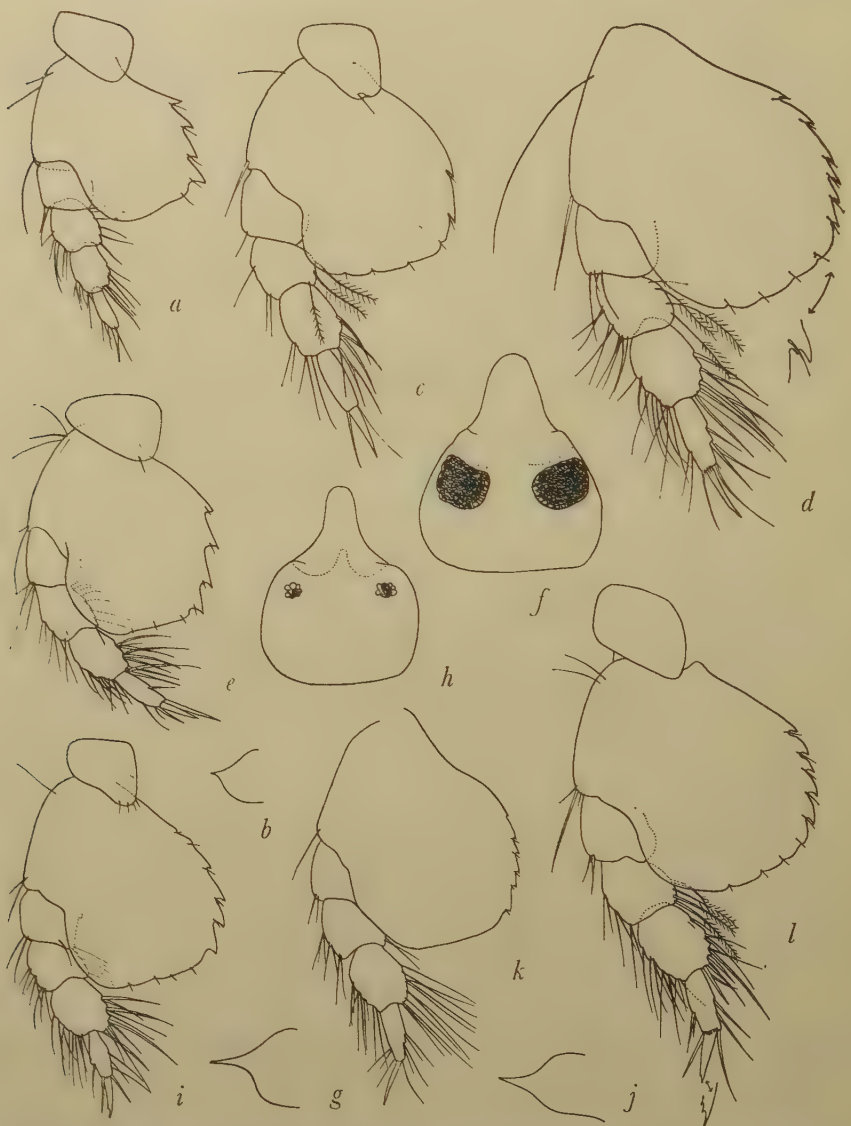

FIGURE 6.—*Paraphoxus fatigans* Barnard, male, 2.5 mm, sta. 6448, variant: *a*, pereopod 5; *b*, epistome. Female, 2.8 mm, sta. 6493, kind 2: *c*, pereopod 5. Male, 3.1 mm, sta. 6426, kind 1: *d*, pereopod 5. Male, 3.5 mm, sta. 6448, variant: *e*, pereopod 5; *f*, head; *g*, epistome. Female, 3.5 mm, sta. 6448, variant: *h*, head; *i*, pereopod 5; *j*, epistome. Female, 3.8 mm, sta. 6426, kind 1: *k*, pereopod 5. Female, 3.0 mm, sta. 6454, kind 1: *l*, pereopod 5.

EXPLANATION OF FIGURE 7

FIGURE 7.—*Paraphoxus fatigans* Barnard, female, 3.0 mm, sta. 6454, kind 1: *a,b*, gnathopod 1. Female, 3.5 mm, sta. 6448, variant: *c,d*, gnathopod 1. Male, 2.5 mm, variant: *e,f*, gnathopod 1. Male, 3.1 mm, sta 6426, kind 1: *g,h*, gnathopod 1. Male 3.5 mm, sta. 6448, variant: *i,j*, gnathopods 1, 2. Female, 2.8 mm, sta. 6493, kind 2: *k*, gnathopod 1.

FIGURE 7.—Explanation on facing page.

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